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ABSTRACT

Separate simultaneous equations models for the educational process for high and low achievers are estimated with two stage least squares for a sample of the 12th grade Coleman data. The nine observed endogenous variables concern cognitive, non-cognitive, and attitudinal factors. The 48 exogenous variables concern demographic, home, peer, teacher, and school effects. Bias resulting from splitting the sample on the basis of the dependent variable is discussed. The results are compared to those for the full sample and the reduced form models to distinguish findings that may arise from this bias. The results suggest that the educational process is similar for the two groups, but that the relationships among some of the endogenous variables and the effects of some exogenous variables are different. In particular, sense of control over the environment affects the achievement of low achievers but not that of high, while self-esteem affects the achievement of high achievers but not of low. Several school and teacher characteristics affect the achievement of high and low achievers differently, suggesting that school resources could be re-distributed to increase achievement. However, the results also suggest that such policies would have detrimental effects on other outcomes for students. (Author)

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Simultaneous Equations Models of the Educational Process for High and Low Achievers*

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1. Introduction

Most single equation regression models of the educational process indicate that home environmental characteristics have more influence on pupil achievement than do school characteristics. The disappointing school findings may have a number of causes. In particular, the usual assumption that school resources affect students uniformly may hide important school effects. For example, if one resource aids blacks and harms whites, these effects may cancel one another in a combined sample of blacks and whites. In fact, the structure of the educational process may differ for the two groups. Such considerations have led researchers to estimate separate models for various ethnic groups and socio-economic levels. Our interest here is slightly different and concerns whether teacher and school characteristics and other variables have different effects on high and low achievers. More generally, we consider similarities and differences in the structure of the educational process for high and low achievers.

Section 2 of this paper briefly considers other simultaneous models of the educational process and describes our model and the variables includes. Section 3 reviews the literature concerning separate models for different subsamples. It focuses on the two other models that include separate effects for high and low achievers. Section 4 is a brief review of the educational and psychological literature which suggests that the educational process may be different for high and low achievers and that teachers and school characteristics may affect the two groups differently. Included in this review is a discussion of aptitude - treatment interaction. Section 5 discusses methodology. The data are briefly described and the effects of division of the sample on the basis of the dependent variable are discussed. Section 6 presents the

results for the endogenous variables. The results for high and low achievers and for the full sample are compared. Section 7 presents the results for selected exogenous variables. The effects of teacher and school characteristics upon achievement and other student outcomes are emphasized. Section 8 discusses the policy implications of our results.

2. Modeling the Educational Process

Simultaneous Models.

Most models of the educational process consist of an "educational production function". In such models pupil achievement or change in pupil achievement is a linear function of sets of i) demographic characteristics of the pupil, ii) home environmental characteristics, iii) peer group characteristics, iv) teacher characteristics, and v) school characteristics. Numerous authors including Coleman et al. (1966), the authors in the volume edited by Mosteller and Moynihan (1972), Hanushek (1972), and Murnane (1975) postulate and estimate these models. Other authors view the educational process as having multiple outputs and incorporate this view into their models. These models are called simultaneous models because the educational outputs are assumed to affect each other simultaneously. Simultaneity is assumed because longitudinal data are usually not available. Simultaneous models are estimated by Levin (1970), Michelson (1970), Gordon (1973) Parti and Adelman (1974), Anderson and Evans (1974), Boardman (1975), Boardman, Davis, and Sanday (1976), and Boardman, Davis, and Lloyd (1974). Some of these models are estimated by path analysis techniques which allow for intermediate outputs but not for feedback effects. The better analyses use two stage least squares techniques which do allow for feedback. Two stage least squares

techniques cannot prove causality. No statistical technique can. However, they do not impose the direction of causality upon the data as path analysis typically does.

This paper is an extension of the work of Boardman, Davis, and Lloyd (1974) (hereinafter called Boardman et al.). In this paper we estimate the model developed there for high and for low achievers. In Section 4 we present our reasons for this separate estimation.

The Endogenous Variables: Outputs of schooling

The endogenous variables in our model are pupil achievement, participation in a college preparatory program, achievement motivation, demonstrated motivation, expectations, self-esteem, belief in the ability to control one's environment, perceived parental expectations, and perceived teacher expectations. We believe that these variables affect one another and should be modeled simultaneously. For a discussion of this question and presentation of a priori hypotheses about the relationships of these variables, see Boardman et al. Here we describe our variables and consider them as outcomes of schooling.[1]

Most regression models of the educational process treat achievement as the exclusive outcome. Indeed, achievement is one of the major outputs. Children should, at the very least, be able to read and write, to understand and use mathematics and possess some general knowledge. Our measure of achievement is an index formed from measures of verbal, non-verbal and mathematical ability and general information.[2]

While school achievement bears some relationship to future occupational success, the evidence fails to show a strong relationship between them.

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[1] For a fuller discussion, see Boardman et al.

[2] All indices are formed from the first component of a principal components analysis.

Jencks et al. (1972), among others, suggests a limited role for school achievement in success in later life. Cognitive psychologists emphasize the role of desires, aspirations and the need for achievement in later success.

We construct reasonable measures of two motivational concepts: i) achievement motivation-- the need or aspiration for achievement and, ii) demonstrated motivation or studiousness. Other psychologists emphasize the role of self-esteem and fate control in the educational process. Coopersmith (1967) defines self-esteem primarily in terms of self-worth. Rotter et al. (1962) distinguish between internal and external control. A person with internal control believes that he has control over his environment. A person with external control believes that he has no control over his environment and this his experiences result from luck, fate, or the actions of others.

The other endogenous variables concern participation in a college preparatory program, individual expectations about college attendance and future occupation and parental and teacher expectations about school preformance.

Beyond their effect on achievement, several of our endogenous variables are important to later success. One can also argue that some of them are valuable even if not related to future success. An example is self-esteem. We believe that such attitudes as motivation, self-esteem, control and expectations should be considered important outputs of the educational process.

The Exogenous Variables

Boardman et al. present a priori hypotheses about the effect of the exogenous variables on the endogenous variables.

The set of exogenous variables contains measures of 1) pupil demographics, such as sex, ethnic group, and age, 2) home environmental characteristics, such as socio-economic status, information in the home, family structure, order of birth, and number of times the pupil changed schools, 3) school peer group characteristics, such as the racial composition of the school and classroom and the average socio-economic background of the students, 4) teacher characteristics, such as the average achievement level of the teachers, teachers' experience, and the number of teachers per pupil, and 5) school characteristics, such as school facilities, problems in the school, and age of school. Appendix A contains operational definitions for all the variables.

3. Modeling Subsample Differences

Most regression analyses, both single equation models and multiple equations models, attempt to control for certain effects by including dummy variables. Typically, analysts include a dummy variable for sex in an attempt to control for male-female differences. This procedure implicitly assumes that the other explanatory variables exert a similar effect for both males and females. If one believes, that teachers' verbal ability makes more of a difference for females than it does for males, one should include an interaction term for sex with teachers' verbal ability. If one believes that the effect of all explanatory variables differs by sex, one should estimate separate models for males and females. Then one can test the coefficients to see if they differ significantly.[3]

A number of analysts believe that the educational process differs markedly for, students of various races and ethnic groups. This

[3] We report tests of significance for coefficients for low and high achievers only in connection with tests of ordinal interaction effects. Given the large sample size, even small differences are significant.

consideration leads them to estimate separate models for each racial or ethnic group; see for example, Coleman et al., (1966), Michelson (1970), Winkler (1972), and Boardman (1975). Hanushek (1972) estimates separate models for students with different socio-economic backgrounds. In this paper we investigate whether models differ depending on the initial achievement level of the student.

Modeling Low and High Achievers

Only two other multiple regression models of the educational process consider differences in the educational process between students of high achievement and students of low achievement. Research by Summers and Wolfe (1975) and Murnane (1975) does not estimate separate models, but includes interaction effects by achievement level.

Summers and Wolfe and Murnane use longitudinal data from cities in the Northeast; the former use data from Philadelphia and the latter uses data from New Haven. Both studies have good quality teacher data and match the student and teacher. Both use regression analysis to determine the factors that affect one or more achievement measures. Summers and Wolfe find that small classes help low achievers, but are of no special benefit to average or high achievers. They also report that in elementary school experienced teachers help high achievers, while inexperienced teachers help low achievers. In junior high experienced teachers help all students, but help high achievers more. Murnane finds that high student turnover impedes the reading progress of high achievers, has no significant effect on the reading of average achievers and has inconclusive effects on the reading scores of low achievers. These authors obtain inconclusive or insignificant results when they test additional hypotheses concerned with interaction by achievement level.

Summers and Wolfe point out that their results have major policy implications. They argue that principals and school administrators can improve the achievement scores of all students by redistributing resources. Thus, improvement in achievement could result without increasing the school budget.

In contrast to the work of Summers and Wolfe and Murnane, we estimate separate models for high and low achievers. Separating the sample is equivalent to including interaction terms for each variable.

4. The Educational and Psychological Literature

The educational literature suggests that, in addition to ability differences, high and low achievers differ in a number of important ways. (Averch et al. 1972). Klein, Barr and Wolitszky (1967) stress personality differences in high and low achievers:

> High achievers show strong internalization of values, indicated by responsibility and socialization. They also have high achievement motivation, in regard to both independent and conforming spheres. They are, however, low on social desirability (need to make a good impression for its own sake) and lack flexibility, apparently preferring order and stability.

These differences lead high and low achievers to react in different ways to characteristics of the educational process.

Teachers react to and interact with students according to their achievement level. Brophy and Good's (1974) review suggests that achievement level is the most important source of differential teacher treatment of students, more important than sex, socio-economic level or ethnic background.

Aptitude - Treatment Interaction

Psychologists recognize the existence of aptitude-treatment interaction effects.[4] Significant interaction effects are disordinal or ordinal. A disordinal interaction indicates that a variable affects two groups with different characteristics in different ways. An ordinal interaction indicates that a variable affects the two groups in the same way but affects one group significantly more than the other.

Early reviews of the aptitude-treatment literature by Bracht (1969) and Cronbach and Snow (1969) find only a limited amount of evidence indicating the existence of aptitude-interaction effects. However, both reviews suggest that better methodology might produce better results. More recently, Berliner and Cahen review the literature on interaction effects which influence measures of learning. They report that demographic characteristics, personality traits, and aptitudes of the student interact with teaching techniques, teaching style and personality of the teacher. In particular, Berliner and Cahen conclude that interaction effects involving differential levels of verbal intelligence warrant further investigation. Cronbach and Snow reach a similar conclusion.

The educational and psychological literature suggests that one can expect interaction effects by achievement level. As discussed above, by estimating separate models for high and low achievers, we allow for interaction effects of every explanatory variable and achievement.

5. Methodology

The data

The data consist of a random sample of twelfth grade students from the survey of Equality of Educational Opportunity. Boardman (1975)

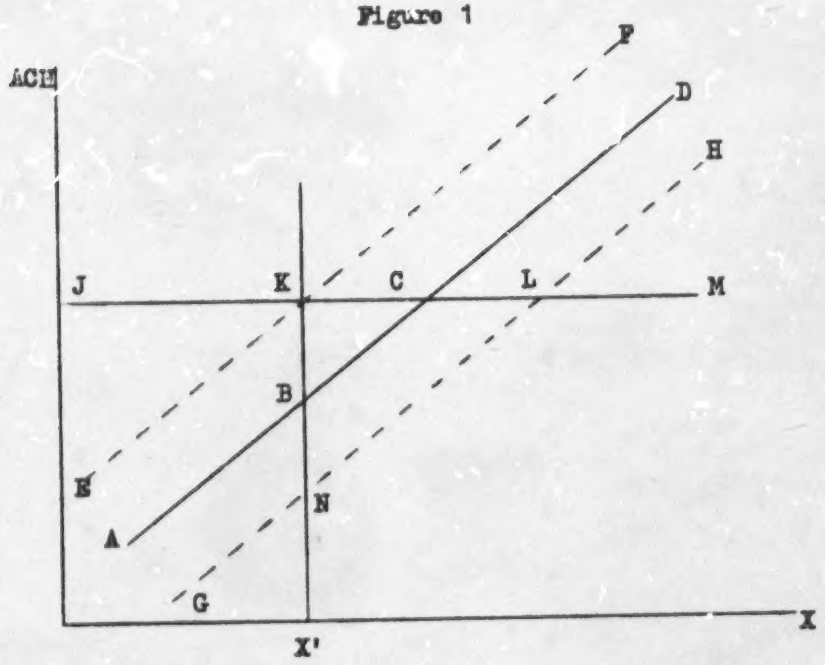
[4] The terms attribute-treatment interaction and trait-treatment interaction are sometimes used as well.

describes the advantages and disadvantages of these data. For this research, we took the sample discussed in Boardman (1975) and split it into three groups: high, middle and low achievers. As indicated above achievement is measured by an index constructed by principal components analysis. For the Boardman et al. sample of 14,974 students the mean achievement score is 0.32167 with a standard deviation of 3.657. We split the sample to put between twenty and twenty-five percent of the students in each of the high and low groups. To this end, a student with an achievement score greater than 3.2 was placed in the high achiever group and a student with an achievement score less than -3.0 was placed in the low achiever group. The other students are not considered here. This procedure resulted in 3521 (23.31% of the original sample) high achievers with an average achievement score of 5.349 and 3107 (20.75%) low achievers with an average achievement score of -4.54.

Truncation Bias

Our method of separating the students into high and low achievers differs from that used by Summers and Wolfe and Murnane in one important respect. Our data is cross-sectional, while theirs is longitudinal. We truncate on achievement at time t, a dependent variable; while they truncate on achievement at time t -1, an exogenous variable. Econometric theory shows that truncation on an exogenous variable (or including interaction terms for an exogenous variable) does not affect the unbiasedness and consistency of the estimates. However, truncation on a dependent variable produces biased and probably inconsistent coefficients. The source of bias is easily understood by examining Figure 1 which depicts the problem in the two-dimensional case.

Figure 1



Consider Figure 1 and suppose that the line ABCD represents the true relationship between achievement and a school resource, X. The lines EF and GH border the scatter plot. Suppose that the sample is truncated from above by the line JM so that observations occur only in the area bordered by EKLG. If a regression line is fitted to the area EKLG, it will have a lesser slope than AC, the true relationship for the subsample. This result occurs because the area BCLN exceeds the area KCB. Another way of stating the problem is that X and the error term are negatively correlated for all X greater than X'. When such correlation occurs the coefficients are not only biased but inconsistent.

For the two-dimensional case the effect is to reduce the absolute value of the coefficient. The result is a conservative estimate. However, this attentuation toward zero does not necessarily occur when the a large number of dimensions is involved. Research on this problem is very recent. Goldberger (1975) has shown that the ordinary least squares

coefficients are biased toward zero in the n-dimensional case, if the explanatory variables are distributed multivariate normally. In the same paper Goldberger presents a case (not distributed multivariate normally) in which some coefficients are biased away from zero. The conditions under which bias away from zero occurs have not been investigated.

Amemiya (1973) proposes an instrumental variable approach and a maximum likelihood approach as means of handling the problem of biased and inconsistent coefficients. Crawford (1975) compares the ordinary least squares estimates based on a full sample of observations with three sets of estimates for a truncated subsample. One set of estimates is based on ordinary least squares techniques, one on the instrumental variable approach, and one on the maximum likelihood approach. Crawford concludes that ordinary least squares techniques produce inconsistent coefficients. However, the other estimation procedures do not seem appreciably better. The coefficients for the instrumental variable approach are closer to the results of the full sample more often than are the maximum likelihood coefficients, but they are also more often biased away from zero than the ordinary least squares estimates. Crawford's conclusions are premised with the assumption that the model for the full sample is also appropriate for the truncated sample. If this assumption is inappropriate, differences in the coefficients may be genuine, rather than the result of bias. One can make no firm conclusions on the basis of the Crawford work alone about the relative strength of these estimation procedures. Comparisons using Monte Carlo techniques would be useful, but have not yet been done.

Crawford's work does suggest that Cain and Watts (1973) and Cain (1975) were correct in supposing that the ordinary least squares estimates are generally biased toward zero. All but one of the coefficients in the

Crawford ordinary least squares model for the truncated sample are biased toward zero.[5] Thus, the present evidence suggests that in practice bias away from zero is the exception rather than the rule.

We hypothesize that the models for the truncated samples are different from that for the full sample and from one another. Our problem is to distinguish results that may be substantially biased from those that are probably genuine. In order to minimize errors due to truncation bias, this research compares the results for high and low achievers in the structural form with the results for the reduced form. When the same pattern of coefficients occurs in the two models, the evidence that the effect is genuine is stronger. We also compare our results with the full sample of Boardman et al. These results are not subject to truncation bias. The fact that a result appears in the full sample as well as the subsamples suggests that it is not a false positive. In addition, we compare our results to those of other authors.

6. Results for the Endogenous Variables

Figure 2 depicts the estimated relationships among the endogenous variables for high and low achievers and the full sample.[6] We do not estimate equations in which perceived parental expectations and perceived teacher expectations are the dependent variables. These variables are peripheral to our interest here.

Perhaps the easiest way to understand the estimated relationships is to examine Figure 2 carefully. The diagrams are comparable to path

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[5] We examined our results on the assumption that the same model was appropriate for the full and truncated samples. We also find that bias is usually toward zero. Crawford reports that the difference in the value of the coefficients were sometimes quite large. In one case a coefficient in his truncated sample is twenty-seven times that for the full sample. We do not find such differences in size in our data.

[6] The coefficients, and t statistics for the reduced form and structural form equations for all models are available from the authors on request.

diagrams and are generally self-explanatory. The results for the separate models are not discussed here. Rather, we compare the three models with emphasis upon those for high and low achievers.

As Figure 2 demonstrates the relationships between the endogenous variables are similar for all models. In each, Achievement (ACH) is associated with what might be thought of as measures of personal efficacy--self-esteem (SELFEST) and sense of control of the environment (CONTROL). In each, perceived parental expectations (PPAEXP) are important for achievement motivation (MOTACH) and for expectations (EXP). Perceived teacher expectations (PTEXP) are important for self-esteem in each model. Participation in a college preparatory program (CPREP) affects expectations in each model. Self-esteem and control interact in each.

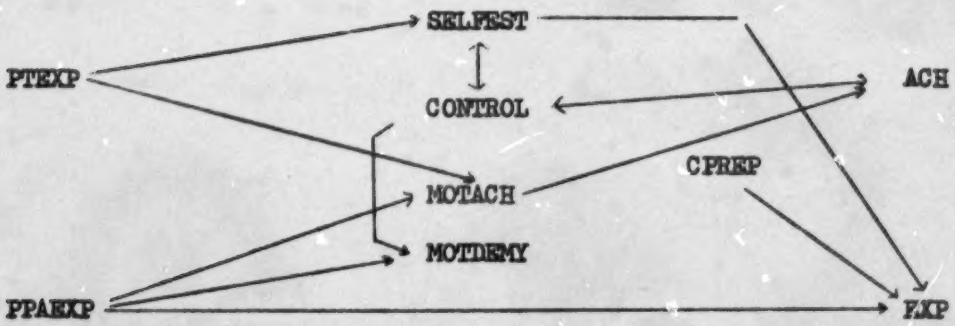
Beyond these common patterns, the models differ considerably. The low achiever model is much less complex than the models for high achievers and the full sample. Perhaps this difference is the most striking of all those between the models. A number of relationships not found to be significant for low achievers are significant for the high achievers. Five of the seven endogenous variables enter more relationships for high than for low achievers. The mean for the low achievers is closer to the point of truncation than is the mean for the high achievers. Therefore, we expect more bias toward zero in the model for the high achievers. Thus differential bias does not offer an explanation for the relative simplicity of the model for low achievers. The greater complexity of the high achievers model is not only a result of more variables interacting with one another; interaction occurs in only one fourth of the estimated relationships for high achievers. Nor is the amount of variance explained consistently greater for the high achievers. For some of the endogenous variables more

FIGURE 2

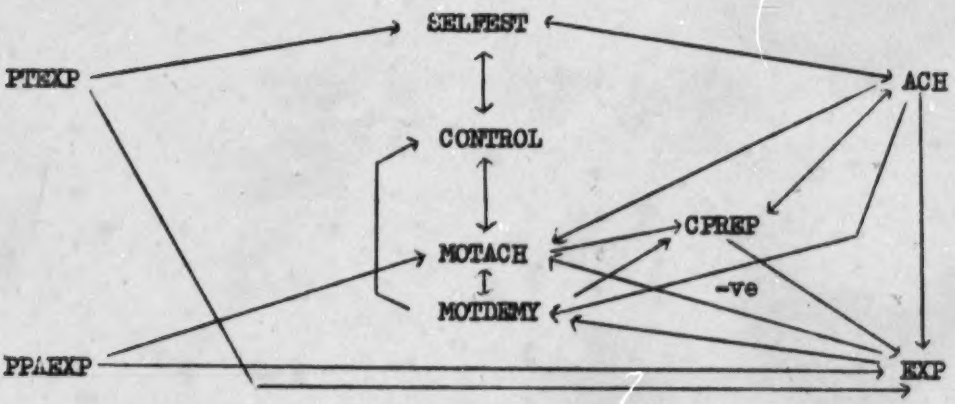
GRAPHS OF THE RELATIONSHIPS AMONG THE ENDOGENOUS VARIABLES (EXCEPT THE DETERMINANTS OF PERCEIVED PARENTAL AND TEACHER EXPECTATIONS)

Structural Form, Estimated by Two Stage Least Squares

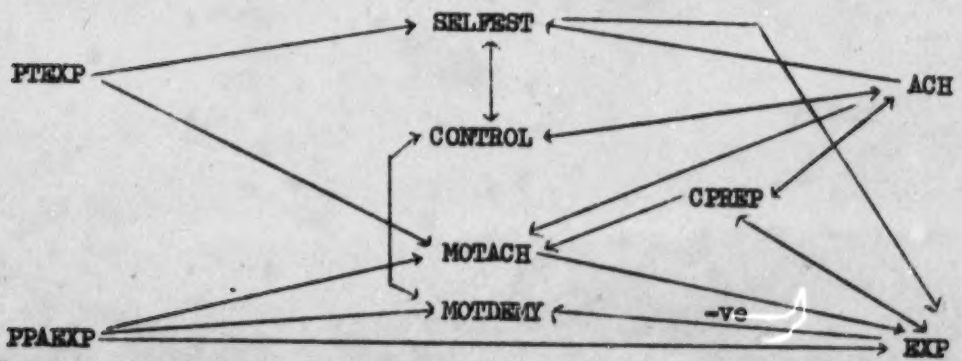
2a LOW ACHIEVERS



2b HIGH ACHIEVERS



2c ALL STUDENTS



See Appendix A for an explanation of the abbreviations.

variance is explained for the low achievers than for the high. (Appendix B presents the R^2 obtained for each of the reduced form and the two stage least squares structural form equations).

The explanatory variables are differentially successful in explaining the variation in scores in the models for high and low achievers. The biggest difference for comparable equations of the two stage least squares structural models in the measures of goodness of fit is that for the equations for participation in a college preparatory program. Here, the R^2 for low achievers is 0.145 versus 0.379 for high achievers. The R^2 for both groups for the achievement equations is low; however, we explain half again as much variation in the low achievers scores (0.235) as in the high. (0.176). We are also more successful in explaining variation in self-esteem among the low achievers (0.609) than among the high (0.453).

Different variables affect achievement in the models. Among low achievers, sense of control and achievement motivation seem to affect achievement; among high achievers, self-esteem and participation in a college preparatory program. In the full sample, control and participation in a college preparatory program affect achievement. Note that of the two efficacy variables, sense of control is important to the achievement of the low achievers and self-esteem is important to the achievement of high achievers. This finding is consistent with that of Coleman et al. (1966, 320) on the relative importance of self-esteem to the achievement of white and Oriental students and of sense of control to black students and other minorities. Of course, the achievement categories are not coincident with the racial categories, but there would be considerable overlap in a national sample.

We estimate that among high achievers achievement feeds back to self-concept, participation in a college preparatory program, demonstrated motivation, achievement motivation, and expectations. For the full sample achievement seems to influence achievement motivation, self-esteem and control. In contrast, among low achievers achievement affects only control. Thus, the impact of achievement seems to be localized among low achievers. The fact that it does not affect self-esteem suggests that it may be less rewarding as well.

There are also differences in the effects of significant others in the models. We estimate that perceived teacher expectations affect the achievement motivation of low achievers and the full sample, but not that of high achievers. However, among high achievers perceived teacher expectations affect the student's expectations. This result does not occur for low achievers or the full sample. Taken together these results suggest that the nature of teacher influence is different for low and high achievers. Parents, too, seem to have different effects upon low and high achievers. For the full sample and among low achievers we estimate that perceived parental expectations affect demonstrated motivation. This result does not hold for the high achievers. Parental expectations do not seem to make high achievers more studious.

7. Results for Exogenous Variables

Charts S1-S4 indicate whether an exogenous variable enters the two stage least squares estimates of the structural form for each of the seven equations for each group studied and whether its estimated effect is positive or negative. Charts R1-R4, presented as Appendix C, provide the same information for the reduced form equations. The structural form estimates concern only the direct effect of the exogenous variables.

In these estimates any effect operating through endogenous variables is excluded from the coefficients for the exogenous variables. The reduced form estimates, on the other hand, provide the total effect of the exogenous variables both directly and indirectly. We discuss primarily two stage least squares estimates of the structural forms in this paper.

The pattern of effects of exogenous variables depicted in Charts S1-S5 is more complex for high than for low achievers. Of the 336 (48 exogenous variables times seven equations) possible relationships for each group, twenty-four percent are significant for low achievers and twenty-nine percent are significant for high achievers. The proportion of significant relationships in each group is larger than one would expect by chance and the difference is just significant at the five percent level. The overall pattern of greater complexity for the high achievers does not hold for each equation if considered individually. For three equations more coefficients are significant for low achievers. However, the number of significant coefficients in these equations is only slightly greater than in the corresponding high achiever equations. In the remainder of this section we discuss selected results for the exogenous variables.

Demographic Variables

We estimate that males have higher achievement scores among high achievers. The results for the full sample also indicate that males tend to have higher achievement scores. We find no significant effect for sex on achievement among low achievers. Our result for low achievers contrasts with that of Summers and Wolfe (1975) who find that among twelfth grade low achievers, males do better than females. We also find, among both high and low achievers, that being female is associated with greater

CHART S1

Demographic Exogenous Variables*
Direction of Significant Relationships**
Structural Form Estimates (Two Stage Least Squares)

		SEX	AGE	BLACK	WHITE	AMIND	ORIENT
ACH	LOW		-	+	+		
	HIGH	-		-		-	
	ALL	-	-	-	+	-	+
CPREP	LOW						
	HIGH				-		
	ALL			+			+
MOTACH	LOW	+		+			
	HIGH			+			
	ALL	+		+		+	+
MOTDEMY	LOW	+	+				+
	HIGH	+	-				+
	ALL	+		+			+
EXP	LOW		-		-		
	HIGH	+			-		
	ALL				-	+	+
SELFEST	LOW		+			-	
	HIGH	-	+	+			-
	ALL			+		-	-
CONTROL	LOW	+	-			+	
	HIGH	+		-	+		
	ALL	+	-		+		

		PRICAN	MEXAM	SMSA	NEWENG	MIDATL	LAKES
ACH	LOW				-	-	
	HIGH		-				
	ALL	-				-	
CPREP	LOW						
	HIGH					+	+
	ALL		+		+	+	+
MOTACH	LOW						
	HIGH	-			-	-	
	ALL		+				
MOTDEMY	LOW		+				-
	HIGH				+		
	ALL		+	+	+		
EXP	LOW					-	-
	HIGH					-	-
	ALL	+			-	-	-
SELFEST	LOW						
	HIGH					+	
	ALL			+		+	
CONTROL	LOW						
	HIGH					-	
	ALL			+			

Demographic Exogenous Variables (cont'd)

		PLAINS	SEAST	SWEST
ACH	LOW		-	
	HIGH		-	
	ALL	+	-	-
CPREP	LOW		+	+
	HIGH			
	ALL		+	
MOTACH	LOW			
	HIGH	-		
	ALL		+	+
MOTDAMY	LOW			
	HIGH			
	ALL			
EXP	LOW	-	-	
	HIGH			
	ALL	-	-	
SELFEST	LOW			-
	HIGH			
	ALL	+		-
CONTROL	LOW			
	HIGH			
	ALL	+		+

*See Appendix A for a description of the variables.

**Sigificant at the 5% level (one-tailed test).

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demonstrated motivation and a greater sense of internal control. However, the association of sex and control is stronger among high achievers than among low and the association of sex and demonstrated motivation is stronger among low achievers. These differences are significant at the five percent level.

Among low achievers and in the full sample being older is associated with lower achievement scores. This result does not hold for the high achievers and may reflect lower achievement among children who are repeating a grade.

We find that among high achievers blacks and members of some other minorities tend to have lower achievement than whites. Similar results hold for the full sample. Summers and Wolfe (1975) also report that blacks tend to have lower achievement scores than whites among high achievers. Among low achievers we find that blacks and whites tend to have higher achievement than other ethnic groups.

The Home Environment

Among low achievers, higher achievement is associated with growing up in the same city. On the other hand, among high achievers, growing up in the same city is associated with lower achievement. The same patterns occur in the reduced form estimates. With such different results for the subsamples, one might well expect to find no significant results for the full sample. Such is the case. The identical results in the reduced and structural forms suggest that this disordinal relationship is genuine. Growing up in the same city probably proxies different behavior patterns for the two groups.

Having two parents is associated with higher achievement in both the structural and reduced form models for low achievers. This variable has no significant effect on either high achievers or the full sample. Again,

identical results in the reduced and structural forms suggest that the result is genuine.

Increased television viewing is associated with higher achievement among low achievers and lower achievement among high achievers. Boardman (1975) using a very similar model to ours found a quadratic relationship between the amount of television viewing and achievement. The effect was first positive and then negative. His results suggest that the diacordinal relationshp estimated is genuine. These results do not necessarily suggest that varying amounts of television viewing cause differential achievement. Television viewing may proxy other behaviors and attitudes. We also find that television viewing is associated with lower achievement motivation among high achievers, and high internal control among low achievers.

Peer Influence

The structural form estimates suggest that the average socio-economic status of schoolmates is more important for high than for low achievers. It is positively associated with the achievement and expectations of high achievers and negatively associated with their achievement motivation and college preparatory program participation. We find a single significant effect for low achievers in the structural form--a negative association with college preparatory program participation. The results for the full sample are similar to those for the high achievers.

Teacher and School Characteristics

The average verbal ability of teachers in the school is positively related to the achievement of both high and low achievers. The same result occurs in the reduced form estimates. In the structural form,

CHART S2

Home Environmental Exogenous Variables*
Direction of Significant Relationships**
Structural Form Estimates (Two Stage Least Squares)

		SES	INFO	TWOP	NOBAS	FL	RBS
ACH	LOW			+			
	HIGH	+	+				
	ALL	+			-	-	
CPREP	LOW	+				-	
	HIGH	+				-	
	ALL	+				-	
MOTACH	LOW						
	HIGH	-		-			
	ALL	-	+	-		+	
MOTDEMY	LOW	-					
	HIGH		+	+	-		
	ALL	-	+				
EXP	LOW	+			+	-	
	HIGH						
	ALL	+	+			-	
SELFEST	LOW						
	HIGH					-	+
	ALL						+
CONTROL	LOW		-		-		
	HIGH					+	
	ALL	+	+		-	+	+

		PRAAT	PTAS	TC	NTCHSCL	LSTCHSCL	TV
ACH	LOW			+			+
	HIGH			-	-	-	-
	ALL				+	+	
CPREP	LOW					-	
	HIGH						
	ALL				-	-	-
MOTACH	LOW			+		+	
	HIGH			+	+		-
	ALL					+	-
MOTDEMY	LOW			+			
	HIGH		-		-	+	-
	ALL	+			-	+	
EXP	LOW	+					
	HIGH			-		+	
	ALL	+		-	-		
SELFEST	LOW				+	-	
	HIGH	-			+		-
	ALL						
CONTROL	LOW				-	+	
	HIGH				-		+
	ALL	-			-	+	

*See Appendix A for a description of the variables.

**Significant at 5% level (one-tailed test).

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CHART S3

Peer Characteristics Exogenous Variables*
Direction of Significant Relationships**
Structural Form Estimates (Two Stage Least Squares)

		AVSES	PWPICLY	PWPICLY2	PWHITE	PWHITE2
ACH	LOW				+	-
	HIGH	+	-			
	ALL	+			-	+
CPSEP	LOW	-			-	+
	HIGH	-			+	-
	ALL	-			-	
MOTACH	LOW			-		
	HIGH	-	+		-	
	ALL		+	-	-	
MOTDEMY	LOW				+	-
	HIGH		+	-	-	+
	ALL		+	-	-	
EXP	LOW					
	HIGH	+				
	ALL	+	-		+	-
SELFEST	LOW		-		+	
	HIGH		-	+	+	-
	ALL				+	-
CONTROL	LOW		+			
	HIGH					
	ALL	-	+			

*See Appendix A for a description of the variables.

**Significant at the 5% level (one-tailed test).

CHART S4

School and Teacher Characteristics Exogenous Variables*
Direction of Significant Relationships**
Structural Form Estimates (Two Stage Least Squares)

		PRPCPREP	FACILITS	PROBLEMS	AGES	TEST	PRNMADEG
ACH	LOW				+		
	HIGH				-	+	
	ALL			-		+	-
CPREP	LOW	+					
	HIGH	+			-		
	ALL	+		+			
MOTACH	LOW			-			
	HIGH	+					
	ALL				+		
MOTDEMY	LOW				+		-
	HIGH						
	ALL				+		-
EXP	LOW						+
	HIGH						
	ALL			-			+
SELFEST	LOW		-				
	HIGH						+
	ALL		-				
CONTROL	LOW				-		
	HIGH						
	ALL						

		TAVR	NTPRPUP	TANYTCH	TASEX	TPTC	TPADTN
ACH	LOW	+	+				
	HIGH	+		+			
	ALL	+	+	+			+
CPREP	LOW						
	HIGH						
	ALL	-		-	-		
MOTACH	LOW						
	HIGH	-	+			+	
	ALL	-					
MOTDEMY	LOW						
	HIGH			+		-	
	ALL		+	+			
EXP	LOW						
	HIGH						
	ALL			+			
SELFEST	LOW						
	HIGH						
	ALL			+		-	+
CONTROL	LOW	+					
	HIGH			-			-
	ALL		-	+			

*See Appendix A for a description of the variables.

**Significant at the 5% level (one-tailed test).

School and Teacher Exogenous Variables (Cont.)

		NTCHLV	NTLKGC	PWTCHLY	
ACH	LOW				
	HIGH	+	+		
	ALL	+			
CPREP	LOW			-	
	HIGH				
	ALL			-	
MOTACH	LOW			+	
	HIGH			+	
	ALL			+	
MOTDEMY	LOW		-	+	
	HIGH			-	
	ALL	-			
EXP	LOW		+		
	HIGH				
	ALL		+		
SELFEST	LOW				
	HIGH				
	ALL		+		
CONTROL	LOW		+		
	HIGH				
	ALL	+	+	+	

the effect of teacher verbal ability is significantly stronger--at almost the five percent level -- for the high achievers than for the low.[6] Average teacher verbal ability also has a positive effect for the full sample. The coefficients of both the high and low achiever models are smaller in absolute value than that for the full model suggesting that bias, if present, is toward zero. This evidence suggests that the ordinal interaction of average teacher verbal ability with achievement is genuine. We also estimate that teacher average verbal ability has a negative effect on the achievement motivation of high achievers and a positive effect on the internal control of low achievers. These results also hold for the reduced form of the model; only the result for achievement motivation holds for the full sample. A relationship between teacher verbal ability and student achievement could result from selection phenomena, as well as from a causal relationship. We control for the possibility that teachers of higher verbal ability seek out schools with more able students by including a measure of average socio-economic status of students in the school in our model.

We find that having more experienced teachers in the school is associated with increased achievement among high achievers. Average teacher experience has no significant effect on the achievement of low achievers. The same results occur in the reduced form model.[7] For the full sample greater average teacher experience is also associated with greater experience. One possible explanation for these findings is that a selection phenomena occurs in which more experienced teachers seek out schools with better students. Our measure of average student socio-economic

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[6] The coefficient for the high achievers is 0.082 and that for the low achievers is 0.063.

[7] The difference in the size of the coefficients for average teacher experience in the reduced form models for low and high achievers is significant at the ten percent level. The coefficient for average teacher experience for high achievers is 0.110 in the structural form.

status in the school controls for this possibility. The Summers and Wolfe (1975) results support the conclusion that experienced teachers increase achievement among high achievers. Their results associate achievement gain with teacher experience. Selection phenomena are not a possible explanation for this result. They find that in elementary school high achievers make larger gains in achievement with experienced teachers and low achievers make larger gains with inexperienced teachers. In junior high experience helps all students, but particularly high ability students.

We also find that teacher experience affects other traits of high and low achievers differently. Having more experienced teachers in the school is associated with greater demonstrated motivation and lower control among high achievers. (We do not find any effect for control in the reduced form). Teacher experience has no significant effect on any outcome among low achievers in the structural form. In the full sample having more experienced teachers in the school is associated with greater demonstrated motivation, expectations, self-concept and control. While the weight of evidence suggests that experienced teachers do increase the demonstrated motivation of high achievers, the negative finding for locus of control is problematic.

We estimate that the number of teachers per pupil is positively associated with the achievement of low achievers, but not that of high in both the structural and reduced forms.[8] This variable also has a positive effect on achievement in the full sample. While the number of teachers per pupil is not identical with class size, our results are consistent with the

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[8]The difference in the size of the reduced form coefficients is significant at the 5% level. The coefficient for number of teachers per pupil for low achievers in 8.210 in the structural form.

idea that smaller classes are beneficial to low achievers. Summers and Wolfe (1975) report that the achievement scores of low achievers increased the most with lower class sizes. We also find that a large number of teachers relative to the number of pupils is associated with increased achievement motivation among high achievers. This result does not hold in the reduced form equations nor for the full sample. The possibility that it is spurious must be entertained.

We find that problems in the school such as vandalism, racial tensions and drugs do not affect the achievement of either low or high achievers, but adversely affect the achievement motivation of low achievers. The coefficient in the reduced form achievement motivation equation for low achievers is also negative, but it is not significant. Summers and Wolfe (1975) report that serious disruptions lower the achievement of high achievers significantly, but harm low achievers much less. It is possible that the difference in our results and those of Summers and Wolfe reflects the measures of school problems used. Our index of problems does not focus exclusively on seriously disruptive incidents.

8. Summary of Results and Policy Implications

Although we find the same general configuration of relationships among the endogeneous variables for the high and low achiever models, our results are consistent with the psychological evidence of personality differences between these groups. Perhaps the most interesting of our results in this regard is the estimated effect of control upon achievement among low achievers and that of self-esteem upon achievement among high achievers. We also find that the model for low achievers is much less complex than that for high achievers. These results are potentially

useful in compensatory programs for low achievers.

Our most interesting results for the exogenous variables concern the effects of school and teacher characteristics. These results have implications for educational policy. It should be noted that our data are for twelfth grade. The policy implications discussed here may not apply at all grade levels.

We find an ordinal interaction between the average verbal ability o teachers in the school and the achievement of low and high achievers. High achievers benefit more. This result suggests that the average level of achievement in a school could be enhanced by a re-distribution of school personnel in which teachers with higher verbal ability were assigned to classes of high achievers. Under this policy the achievement of high achievers would be enhanced more than that of low achievers would be diminished. Let us set aside the question of whether it is advisable to increase average achievement at the expense of a greater variance in achievement.[9] The policy has deterimental effects for other student outcomes. Our results suggest that such a policy would decrease the achievement motivation of high achievers and diminish the sense of control as well as the achievement of low achievers. Clearly, such a policy involves complex trade-offs.

We find that having experienced teachers in the school results in greater achievement among high achievers but has no significant effect on low achievers. However, we also find that having experienced teachers adversely affects the internal control of high achievers. While this result occurs in a single model, and must be considered tenative, it does suggest that a policy of re-distribution of teaching personnel in which high achievers were assigned to more experienced teachers and low achievers to less experienced teachers must be approached with caution,

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[9]For a discussion reduction in variance as a goal of educational policy, see Klitgaard, (1975).

apart from any effect on low achievers.

We find that the number of teachers per pupil affects achievement among low achievers but not among high. Our results suggest that a policy in which low achievers were assigned to relatively smaller classes and higher achievers to relatively larger classes would increase the average level of achievement in the school and decrease the variance in achievement in the school. However, we also find that more teachers per pupil positively affects achievement motivation among high achievers. While this result is tenative, it again suggests that caution is warranted in consideration of policies on re-distribution of school resources.

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APPENDIX A: VARIABLES' DESCRIPTION

Variable Name	MEAN H	MEAN L	Standard Deviation H	Standard Deviation L	Description
Endogenous VARIABLES					
ACH	5.349	-4.54	1.523	1.116	Achievement; an index constructed from the number of correct verbal, general informational, reading, nonverbal and mathematical answers ($\alpha \simeq 0.91$)[1]
CPREP	0.753	.144	.431	.351	College preparatory program; in a college preparatory programs = 1, otherwise (general or vocational) = 0.
MOTACH	0.848	-.557	1.412	1.592	Need for achievement; an index constructed from how far the pupil wants to go in school, how good the student wants to be in school, how happy to quit school ($\alpha \simeq 0.56$)
MOTDEMY	0.143	-1.140	1.531	1.692	Demonstrated motivation; as index constructed from number of hours study and how often pupil stays away because he doesn't want to come ($\alpha \simeq 0.40$)
EXP	1.145	-.667	1.539	1.395	Expectations; an index constructed from occupational expectations and plans about college ($\alpha \simeq 0.56$)

[1] All indices come from the first component of a principal components analysis. The indices correlate positively with each other. The variables appear in the same order as the magnitude of the absolute value of their loadings. Thus, verbal right loads higher than general informational right which, in turn, loads higher than reading right, etc. The number in parentheses equals approximately coefficient α. See Cronbach (1951).

Variable Name	Mean H	Mean L	Standard Deviation H	Standard Deviation L	Description
SELFEST	1.100	-1.009	1.817	2.127	Self esteem; an index constructed from sometimes student feels he cannot learn, teachers go too fast, would change to be someone different, able to do many things well, assessment of own ability ($\alpha \simeq 0.65$)
CONTROL	0.814	-1.042	1.161	1.642	Internal control or belief in the ability to control one's environment; an index constructed from good luck is more important than hard work for success, everytime get ahead something stops me, whatever education hard to get job ($\alpha \simeq 0.59$)
PPAEXP	1.190	-.682	3.934	2.417	Perceived parents' expectations; an index construction from education mother wants student to have, education father wants student to have, how well father wants student to do in class, and how well mother wants student to do in class ($\alpha \simeq 0.76$)
PTEXP	-3.724	-4.603	1.468	1.741	Perceived teachers' expectations; teachers expect student to be one of the best in class = -2,...., good enough to get by = -8.
SEX	2.870	3.020	0.990	0.996	Sex; male = 2, female = 4
AGE	3.863	4.306	0.737	1.110	Age; less than 14 = 1, ..., 20 or older = 7
SES	1.556	-1.022	2.309	2.049	Socio-Economic Background; an index constructed from father's and mother's educational level, father's occupational level, encyclopedia in home, attended kindergarten school, number of people per room in the house, attended Nursery school and number of hours work for pay ($\alpha \simeq 0.65$)

Variable Name	Mean		Standard Deviation		Description
	H	L	H	L	
INFO	0.933	0.512	1.522	1.912	Available Information in the Home; an index constructed from number of books in home, daily newspaper in home, number of magazines in home, dictionary in home, and trips to library ($\alpha \simeq 0.54$)
TWOP	0.762	0.542	0.426	0.498	Two Parents; two parents alive and living at home = 1, otherwise = 0.
NOBAS	2.190	3.575	1.681	2.452	Number of Older Brothers and Sisters; none older = 1,...,8 or more older = 9.
FL	3.301	3.220	0.963	1.131	Foreign Language; frequently speak a foreign language out of school = 1,..., never speak a foreign language = 4.
RBS	2.641	2.283	1.175	1.208	Reading Before School; not read before going to school = 1,..., regularly read before going to school = 4.
PTAAT	1.725	1.827	1.043	1.069	Parents Attend PTA: parents not go to PTA = 1,..., parents go most of the time = 4.
PTAS	1.921	1.986	1.099	1.089	Parents Talk About School; parents talk about school once a day = 1,..., parents never or hardly ever talk about school = 4.
TC	0.760	0.719	0.427	0.450	This City; spent most of life in this city or town = 1, otherwise = 0.
NTCHSCL	2.499	2.552	1.529	1.485	Number of Times Changed School; never changed school = 1,..., changed school four or more times = 5.

Variable Name	Mean H	Mean L	Standard Deviation H	Standard Deviation L	Description
LSTCHSCL	6.182	5.799	1.512	1.814	Last Time Changed School; changed school within a year = 2,..., changed school five or more years ago = 7.
AVSES	.737	-.433	0.925	1.039	Average Socio-Economic Background.
PWPICLY	3.822	2.334	1.216	1.411	Proportion of White Students in Class Last Year; no whites = 1,..., all white = 5.
PWPICLY2	16.085	7.436	8.052	7.855	PWPICLY**2
PWHITE	8.781	4.616	3.430	3.912	Proportion of white students in the school; no white = 1,..., all white = 12.
PWHITE2	88.865	36.607	47.450	45.563	PWHITE**2
TAVR	25.328	23.027	1.076	3.136	Teachers' Average Verbal Right; teachers' average verbal right for all teachers in the school.
NTPRPUP	0.044	0.042	0.008	0.067	Number of Teachers Per Pupil.
TANYTCH	4.463	4.372	0.708	0.637	Teachers' Average Number of Years Teaching; No years teaching = 1,..., 30 or more years = 8.
PWTCHLY	4.240	2.773	1.301	1.726	Proportion of White Teachers Last Year; no white teachers = 1,..., all white teachers = 5.
TASEX	2.913	2.945	0.292	0.267	Teachers' Sex; all males = 2,..., all females = 4.
TPTC	0.402	0.439	0.231	0.254	Proportion of Teachers from This City; all from this city = 1,..., none from this city = 0.
TPADTN	0.112	0.113	0.147	0.128	Teachers' Problems with Administration; lack of effective leadership = 1, ..., no problem = 0.

Variable Name	Mean		Standard Deviation		Description
	H	L	H	L	
FACILITS	12.696	12.125	1.335	2.156	School Facilities; a combination of principal's responses about library, auditorium, gymnasium, laboratories, etc.
PROBLEMS	167.31	168.27	2.055	2.497	Problems in the school; a combination of principal's responses about problems of damage, discourtesy and violence to teachers, racial tension, stealing, drugs, and drink (high value means many problems)
AGES	4.798	4.556	1.786	1.645	Age of school; main classroom less than one year old = 1,..., more than 39 years old = 7.
PRPCPREP	.439	.321	0.158	.125	Proportion of students in College preparatory program
TEST	1.787	1.696	0.427	0.498	Test; school gives intelligence tests and standardized achievement tests = 2, school gives intelligence or standard achievement tests = 1, otherwise = 0.
NTCHLV	2.283	1.991	1.445	1.301	Number of Teachers who Leave; less than 5% left = 1,..., more than 50% left = 7.
PRNMADEG	4.207	4.216	0.659	0.598	Principal has M.A. Degree; no degree = 1, ..., Doctorate = 6.
SMSA	1.254	1.415	0.435	0.493	Standard Metropolitan Statistical Area; within metropolitan area = 1, otherwise = 2.
NEWENG	0.049	0.013	0.217	0.114	New England; New England States = 1, otherwise = 0.

Variable Name	Mean		Standard Deviation		Description
	H	L	H	L	
MIDATL	0.212	0.202	0.410	0.401	Mid Atlantic; Mid Atlantic States = 1, otherwise = 0.
LAKES	0.158	0.103	0.365	0.304	Great Lakes; Great Lakes States = 1, otherwise = 0.
PLAINS	0.074	0.013	0.252	0.111	Plains; Plains States = 1, otherwise = 0.
SEAST	0.123	0.370	0.329	0.483	Southeast; South Eastern States = 1, otherwise = 0.
SWEST	0.061	0.112	0.239	0.315	Southwest; South Western States = 1, otherwise = 0. (Farwest excluded)
NTLKGC	2.901	2.233	1.211	1.258	Number of Times Talk to Guidance Counselor; not once = 1,..., six or more times = 5.
NHWTV	3.594	4.034	1.928	2.241	Number of Hours Watch T.V.; not watch T.V. = 1,...,4 or more hours a day = 7.
CONST	0.000	0.000	1.000	1.000	Constant
BLACK	8.606	0.441	0.280	0.497	Black; Black = 1, otherwise = 0.
WHITE	5.507	0.061	0.497	0.240	White; White = 1; otherwise = 0.
AMIND	0.041	0.068	0.199	0.252	American Indian; Native American = 1; otherwise = 0.
ORIENT	0.153	0.032	0.360	0.176	Oriental; Oriental = 1, otherwise = 0.
PRICAN	0.034	0.125	0.180	0.231	Puerto Rican; Puerto Rican = 1, otherwise = 0.
MEXAM	0.070	0.204	0.255	0.403	Mexican American; Mexican American = 1, otherwise = 0. (Students who fail to put themselves in any one of the above categories constitute the excluded category)

Appendix B

Measures of Goodness of Fit in Each Equation

Structural Form Equations (Two Stage Least Squares)*

	LOW	HIGH	ALL
ACH	0.235	0.176	0.553
CPREP	0.145	0.379	0.441
MOTACH	0.532	0.632	0.595
MOTDEMY	0.304	0.388	0.264
EXP	0.316	0.475	0.514
SELFEST	0.609	0.453	0.434
CONTROL	0.390	0.372	0.303

Reduced Form Equations

ACH	0.141	0.135	0.406
CPREP	0.110	0.197	0.227
MOTACH	0.255	0.287	0.247
MOTDEMY	0.205	0.250	0.209
EXP	0.173	0.218	0.259
SELFEST	0.103	0.145	0.129
CONTROL	0.085	0.180	0.182

* In calculating the R^2 for the two stage least squares estimates of the structural form equations, we use the observed values rather than the predicted values (from the first stage).

APPENDIX C

CHART-R-1
Demographic Exogeneous Variables*
Direction of Significant Relationships**
Reduced Form Estimates

		SEX	AGE	BLACK	WHITE	AMIND	ORIENT
ACH	LOW		-				
	HIGH	-		-	+	-	
	ALL	-	-	-	+		+
CPREP	LOW		-				
	HIGH		-	+			+
	ALL	-	-	+	+	+	+
MOTACH	LOW		-	+	-		
	HIGH		-	+	+		+
	ALL	-	-	+	+	+	+
MOTDEMY	LOW	+		+			
	HIGH	+	-	+			+
	ALL	+	-	+	+		+
EXP	LOW	-	-		-		
	HIGH		-				+
	ALL	-	-	+	+	+	+
SELFEST	LOW	+	-				
	HIGH	-		+	+		-
	ALL		-	+	+	-	
CONTROL	LOW	+	-				
	HIGH	+	-		+	+	
	ALL	+	-	+	+		+

		FRICAN	MEXAM	SMSA	NEWENG	MIDATL	LAKES
ACH	LOW	-	-	+	-	-	
	HIGH		-				
	ALL	-	-		-	-	
CPREP	LOW						
	HIGH						+
	ALL						
MOTACH	LOW						
	HIGH	-			-	-	
	ALL				-	-	-
MOTDEMY	LOW			+			-
	HIGH						
	ALL			+		-	-
EXP	LOW					-	-
	HIGH					-	
	ALL		-		-	-	-
SELFEST	LOW		-	+			
	HIGH						
	ALL			+			
CONTROL	LOW		-	+			
	HIGH				-	-	
	ALL			+			

*See Appendix A for a description of the variables.

**Significant at the 5% level (one-tailed test).

Demographic Exogenous Variables (cont'd)

		PLAINS	SEAST	SWEST	
ACH	LOW				
	HIGH				
	ALL	+	-		
CPREP	LOW		+		
	HIGH				
	ALL			+	
MOTACH	LOW		+	+	
	HIGH	-		+	
	ALL		+	+	
MOTDENY	LOW			+	
	HIGH		+		
	ALL		+	+	
EXP	LOW				
	HIGH			+	
	ALL		-	+	
SELFEST	LOW				
	HIGH				
	ALL	+	+	+	
CONTROL	LOW				
	HIGH				
	ALL	+		+	

*See Appendix A for a description of the variables.

**Significant at the 5% level (one-tailed test).

CHART R-2

Home Environment Exogenous Variables*
Direction of Significant Relationships**
Reduced Form Estimates

		SES	INFO	TWOP	NOBAS	FL	RBS
ACH	LOW	+	+	+			+
	HIGH	+	+				
	ALL	+	+	+	-	-	+
CPREP	LOW	+				-	+
	HIGH	+	+		-	-	
	ALL	+	+	+	-	-	+
MOTACH	LOW	+	+				+
	HIGH	+	+		-	-	+
	ALL	+	+		-	-	+
MOTDEMY	LOW		+	+	-	+	+
	HIGH	+	+	+	-	-	
	ALL		+	+	-	-	+
EXP	LOW	+	+				+
	HIGH	+	+		-	-	+
	ALL	+	+	+	-	-	+
SELFEST	LOW	+					+
	HIGH	+	+			-	+
	ALL	+	+		-	-	+
CONTROL	LOW	+					+
	HIGH	+	+	+		+	+
	ALL	+	+	+	-		+

		PTAAT	PTAS	TC	MTCHSCL	LSTCHSCL	TV
ACH	LOW	-		+			+
	HIGH		+	-	-		-
	ALL	-	+	+		+	-
CPREP	LOW					-	
	HIGH		-		-		-
	ALL	+	-		-		-
MOTACH	LOW	+	-	+		+	
	HIGH		-			+	-
	ALL	+	-			+	-
MOTDEMY	LOW	+	-		-	+	
	HIGH		-		-	+	-
	ALL	+	-		-	+	-
EXP	LOW	+	-				-
	HIGH		-	-	-	+	-
	ALL	+	-	-	-	+	-
SELFEST	LOW		+		-	+	
	HIGH						-
	ALL				+	+	-
CONTROL	LOW				-	+	
	HIGH		-		-		
	ALL			+	-	+	-

*See Appendix A for a description of the variables.

**Significant at the 5% (one-tailed test).

Chart R-3

Peer Characteristics Exogenous Variables*
Direction of Significant Relationships**
Reduced Form Estimates

		AVSES	PWPICLY	PWPICLY2	PWHITE	PWHITE 2
ACH	LOW		-	+	+	-
	HIGH		-	+		
	ALL		-	+		+
CPREP	LOW	-				
	HIGH	-			+	-
	ALL	-	-	+		
MOTACH	LOW	-	-	+		
	HIGH	-	+		-	
	ALL	-	-	+		
MOTDEMY	LOW	-	-	+	+	-
	HIGH		+	-	-	
	ALL	-	+	-	-	
EXP	LOW	-			+	
	HIGH	-				
	ALL	-	-	+	+	-
SELFEST	LOW	-				
	HIGH	-	-	+	+	-
	ALL	-	-	+	+	-
CONTROL	LOW	-				
	HIGH					
	ALL	-				

*See Appendix A for a description of the variables.

**Significant at the 5% level (one-tailed test).

CHART R-4

School and Teacher Characteristics Exogenous Variables*
Direction of Significant Relationships**
Reduced Form Estimates

		PRPCPREP	FACILITS	PROBLEMS	AGES	TEST	PRNMADEG
ACH	LOW				+		
	HIGH	+		+			
	ALL	+	-	-		+	-
CPREP	LOW		-				
	HIGH	+			-		
	ALL	+					
MOTACH	LOW	+			+		+
	HIGH	+				-	
	ALL	+				-	+
MOTDEMY	LOW						
	HIGH	+				-	
	ALL	+	-		+	-	-
EXP	LOW	+					+
	HIGH	+				-	+
	ALL	+	-	-		-	+
SELFEST	LOW			+	-		
	HIGH					-	+
	ALL	+	-				+
CONTROL	LOW			+	-		
	HIGH						
	ALL	+	-				

		TAVR	NTPRPUP	TANYTCH	TASEX	TPTC	TPADTN
ACH	LOW	+	+				
	HIGH	+		+			
	ALL	+	+	+			+
CPREP	LOW						
	HIGH						
	ALL						
MOTACH	LOW	-					
	HIGH	-				+	
	ALL	-		+			
MOTDEMY	LOW			+	+		
	HIGH			+			
	ALL			+			
EXP	LOW						
	HIGH		-				
	ALL	-		+	+		
SELFEST	LOW	+		+			
	HIGH	-					-
	ALL			+			
CONTROL	LOW	+		+			
	HIGH						-
	ALL	+		+			+

*See Appendix A for a description of the variables.

**Significant at the 5% level (one-tailed test).

School and Teacher Characteristics Exogenous Variables
(cont'd.)

		NTCHLV	NTLKGC	PWTCHLY
ACH	LOW		+	+
	HIGH	+	+	
	ALL	+	+	+
CPREP	LOW			-
	HIGH		+	
	ALL		+	
MOTACH	LOW		+	+
	HIGH		+	+
	ALL	+	+	+
MOTDEMY	LOW		+	+
	HIGH		+	
	ALL	-	+	+
EXP	LOW		+	
	HIGH		+	
	ALL	+	+	+
SELFEST	LOW		+	
	HIGH	-	+	
	ALL	+	+	+
CONTROL	LOW		+	
	HIGH		+	
	ALL	+	+	+

*See Appendix A for a description of the variables.

**Significant at the 5% level (one-tailed test).